UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 West Jackson Boulevard
Chicago Illinois 60604

In early May, 1997, the EPA released its finalized version of the detailed risk assessment it had conducted regarding the Waste Technologies Industries ("WTI") facility in East Liverpool, Ohio.

We believe this is the most detailed and scientifically sound risk assessment ever conducted for such a facility. Our initial conclusion is that the risk assessment did not show significant risks associated with the operation of WTI. In addition, we learned that in order to more effectively regulate this facility, we might want to consider placing annual limits on the emissions of certain metals, over and above the hourly limits already in the permit (and those additional limits have now been imposed on WTI). It is also our hope that the accident analysis, which is also part of the risk assessment document, will be a useful resource for the appropriate emergency planning agencies.

This risk assessment was designed to be a regulatory tool which was based on sound science. Accordingly, the risk assessment was conducted in association with top EPA scientists in this field, as was the subject of two complete peer reviews by independent scientists.

EPA Region 5, who directed this project, had scheduled completion of the entire risk assessment document for early May, 1997, and this particular time frame had been represented to Congressmen, to our contractors/subcontractors, to several members of the public, to the Ohio EPA, and to WTI. However, towards the end of April, the U.S. EPA made the decision to send one new section of the accident analysis for a third peer review, to be performed by a subgroup of the original peer reviewers. It was deemed appropriate to have this section of the accident analysis reviewed further because the methods used to calculate the chemical concentrations and probabilities for the East Elementary School (a new analysis which was conducted in response to the previous peer review) in this new section of the accident analysis had never been used before.

In order to fulfill stakeholder expectations while still including additional scientific peer review, the risk assessment document was finalized and released on schedule, with the understanding that an addendum would be issued if deemed appropriate based on the comments of the new peer review. This was clearly stated in the "charge" to the peer reviewers.

The third peer review was initiated for the express purpose of reviewing those issues associated with the methodology, concentrations, and probabilities related to the analysis of the impacts of accidents on the School.

Peer reviewers often tend to comment on areas outside their charge, and call for additional work. Peer reviews are initiated to bring objective expertise to new and difficult areas. They are not

expected to achieve consensus. Disagreement is the essential fuel that drives science forward, and this disagreement is expected to show up in any collection of experts. However, the EPA is committed to considering and addressing all comments, even those outside the charge.

ORD issued its charge (included) to selected peer reviewers on May 2, 1997. We have now received copies of comments from the seven peer reviewers whom ORD requested to conduct this review, along with ORD's recommendations. Comments from the reviewers could be summarized as follows:

1) Regarding the specific issues in the ORD charge (i.e., the concentrations/probabilities at the school in Volume VII of the risk assessment document), all seven peer reviewers basically found that the analysis that EPA Region 5 did was acceptable. Several reviewers found that one particular part of the analysis did not add anything to the report, and one thought that part should be removed.

2) Three of the scientists commented negatively on other areas of the accident analysis.

3) One of the scientists commented negatively on aspects of the human health risk assessment (Volume V of the risk assessment document).

4) Three of the scientists basically thought the accident analysis was acceptable, or had only very minor suggestions.

The EPA is presently analyzing the comments. EPA management is determining which EPA offices are the best equipped to address each concern, and what additional studies might be appropriate.

Copies of the peer reviewers' comments, and ORD's recommendations, are included. Because we were not provided with electronic copies of the reviewer's letters, it was necessary to retype these documents. We have tried to faithfully transcribe all the peer comments, and apologize for any typographical errors which we may have missed.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
RESEARCH AND DEVELOPMENT

April 28, 1997

Walter Dabberdt
Associate Director
National Center for
Atmospheric Research

Dear Dr. Dabberdt

On January 11, 1996 you participated in a peer review of the EPA Region V risk assessment for the Waste Technologies Industries' (WTI) hazardous waste incinerator located in East Liverpool, Ohio. Several recommendations from this review were focussed on enhancing the accident analysis portion of the risk assessment. In particular, peer reviewers recommended that the accident analysis be made more transparent by explicitly reporting the chemical concentration ranges estimated to occur at the East Elementary School during various accident scenarios. Region V has addressed the 1996 peer review recommendations in the WTI risk assessment report. In addition to providing upper bound chemical concentrations, Relative Hazard Ratios (RHR) have been calculated based on Levels of Concern (LOC) for the chemicals evaluated in the accident scenarios. Further, probabilities of achieving these concentrations and RHRs at East Elementary School have been estimated by taking into account the fraction of the year during which the wind blows from WTI toward the school.

The accident analysis is an important component of the WTI risk assessment. Therefore, EPA has decided to organize a peer review of the additional analyses pertaining to the East Elementary School conducted in response to the January 1996 peer review recommendations. Should changes to the accidental release analysis be necessitated by the recommendations from this review, Region V will issue an addendum to the final WTI risk assessment report. Participants for this review are listed in the Attachment. These participants were selected from the Air Dispersion/Deposition Modeling and Accident Analysis subgroup of the 1996 peer review. This group was supplemented with the Chair of the Workshop, who was also a member of the Exposure Assessment subgroup, and the Chair of the Toxicology subgroup. These three subgroups provided the bulk of the accident analysis recommendations during the 1996 review.

As a participant in the current review, you are asked to review and comment on the revisions to the accident analysis (Volume VII of the risk assessment) related to the assessment prepared for East Elementary School. During your review, consider such questions as:

> The SLAB air dispersion model, used for the dense gas releases in the accident analysis, assumes flat terrain while the East Elementary School is at a higher elevation than WTI. The Agency believes that the use of the SLAB model provides conservative concentration estimates in complex terrain applications. Therefore, the ISC3 model was used to develop a better understanding of how terrain effects might influence concentrations at the height of the school. Do you agree that 1) the SLAB model provides conservative concentration estimates at the school and 2) that the ISC3 sensitivity analysis contributes to our understanding of the terrain effects?
>
> Is the Relative Hazard Ratio (RHR) approach, coupled with estimates of relative occurrence, appropriate for identifying those accident scenarios with the greatest potential to cause adverse health effects at East Elementary School?
>
> Is the approach to developing the probabilities of achieving the estimated concentrations and RHRs at East Elementary School appropriate?

Volume VIII of the risk assessment ("Additional Analysis in Response to Peer Review Recommendations") and the appendices to Volume VII are being provided as supplemental information to assist with your review. Please use the enclosed Federal Express return envelope to send me your written comments and any additional information on or before May 19.

Dr. Robert Huggett (Assistant Administrator for Research and Development) remains committed to the EPA policy of using peer review as a means of ensuring the use of sound science in Agency assessments. Therefore, your assistance with this review is greatly appreciated and your comments and recommendations will be addressed. If you have any questions or if I can be of further assistance, please call me (202-260-6743).

Attachments (1)

Sincerely yours,

William P. Wood
Executive Director
Risk Assessment Forum

Attachment 1

Accident Analysis Peer Review Participants

WalterDabberdt	303-497-1108
Mark Garrison	610-524-3500
Halstead Harrison	206-543-4596
Jerry Havens	501-575-2055
Robert Meroney	970-491-8574
Thomas McKone	510-642-8771
Mary Davis	304-293-3414

MEMORANDUM

SUBJECT: WTI Risk Assessment: Review of Accident Analysis Issues

FROM: Henry L. Longest, II
Acting Assistant Administrator (8101)

TO: Timothy Fields, Jr.
Acting Assistant Administrator
Office of Solid Waste and Emergency Response (5101)

Dave A.Ullrich
Acting Regional Administrator
Region V

The seven external peer reviewers have completed their review of the revisions to the accident analysis portion of the EPA risk assessment for the WTI incinerator. These reviewers agree that the revised accident analysis is responsive to many of the recommendations made during the January 1996 peer review workshop and is an improved analysis. Several of the reviewers commented on the benefits of the revisions related to East Elementary School including the use of Level of Concern (LOC) values for defining offsite vulnerability zones.

The charge letter sent to the external reviewers asked for specific input in three areas: the conservatism of the SLAB model for predicting concentrations at East Elementary School, the appropriateness of the use of the Relative Hazard Ratios (RHRs) for identifying accident scenarios with potential impacts at the school, and the appropriateness of the approach to developing the probabilities of achieving the estimated concentrations and RHRs at the school. Reviewers generally agreed that the use of RHRs was appropriate and that the SLAB model would provide conservative estimates of the concentrations achieved at East Elementary School.

Several of the external peer reviewers commented that additional analysis was needed to address some of the technical issues raised during the 1996 peer review. These reviewers have recommended that further revisions be made to the present version of the WTI accident analysis.

Key recommendations of the peer reviewers are summarized below. For additional details, refer to the attached individual reviews.

1. The process used to define accident scenarios is still based primarily on qualitative and subjective methods. The scenarios are based on engineering judgment derived from experiences at WTI and similar facilities. Although this type of process is useful for screening out plausible extreme cases, some reviewers felt that it lacks credibility relative to the more sophisticated fault and event tree methods used in other industries and at other chemical facilities (see comments from McKone). These reviewers recommend that the rationale for selecting accident scenarios and for evaluating the effectiveness of mitigation measures should be based on a more structured, quantitative method such as a fault or event tree (see comments from McKone and Havens). Although the reviewers did not recommend a mechanism for conducting this type of analysis, one possibility could be to incorporate it into the broader emergency management planning process.

2. The consequences of an aerosol jet release scenario should be quantitatively evaluated in the accident analysis and only dismissed as a significant source of risk if supported by a more rigorous quantitative evaluation of probability (see comments from Havens and McKone).

3. The probabilities of achieving the estimated concentrations at East Elementary School were derived by coupling the estimated probability of an accident occurring with the estimated probability that the wind would be blowing toward the school at the time of the accident. One peer reviewer commented that the use of wind data collected at the WTI site may not be appropriate for this analysis (because of the topography and the location of the school). Given this uncertainty, the 20° arc of wind direction used to estimate the probability is considered too narrow. This peer reviewer suggests that a broader arc should be used in light of the uncertainties presented by the wind data (see comments from Dabberdt).

4. It should be noted in the accident analysis report that sophisticated models for accidental fires and chemical releases are lacking. The uncertainty that this introduces into the assessment should be characterized. Also, a better discussion of the rationale behind selecting particular models should be provided (see comments from McKone and Dabberdt).

5. An analysis and discussion of the accident data from the Biebesheim, Germany incinerator should be provided (see comments from McKone).

6. The use of such data as emergency room admissions for asthma as an index of air quality in the vicinity of WTI should be discussed in the analysis (see comments from Harrison). ORD staff have learned that the Office of Air Quality Planning and Standards may have information pertaining to respiratory illness and Ozone, acid

aerosol, and particulate emissions. This information could be used to inform this discussion.

To address the above comments, I recommend that Region V prepare an addendum to Volume VII of the risk assessment, as described by Tim Fields in his April 15 note to Bob Huggett. This addendum should consider all issues discussed in the attached reviews. This recommendation is based primarily on the concerns expressed by the external peer reviewers that the current version of the accident analysis does not adequately address some of the issues raised during the 1996 peer review. Also, it is our understanding that Region V will be distributing copies of the peer reviewers' comments to stakeholders and will post complete copies of the individual reviews on its HomePage. If you have any questions concerning this review, please contact Bill Wood at 202-260-6743.

Attachments

PEER REVIEW OF THE ACCIDENT ANALYSIS OF THE FINAL WTI RISK ASSESSMENT REPORT ISSUED IN APRIL 1997

Thomas E. McKone, Ph.D.,
Lawrence Berkeley National Laboratory
and
School of Public Health
University of California
Berkeley, California

May 19, 1997

This review is in response to a request forwarded to me by William Wood's letter which I received on May 5, 1997. This letter requested that I review and comment on the revisions to the accident analysis and return my review to EPA by May 19. My review here has two components: (1) overview comments on the revised accident analysis as well as my sense of how well the revised accident analysis addresses general issues raised in the 1996 peer review regarding methodology, assumptions, and treatment of uncertainties and (2) my evaluation of how well the revised accident analysis responds to the list of major individual issues on accident analysis raised in the 1996 peer review.

General Issues

Because the time available for my review was limited--less than two weeks; the amount of material involved was quite lengthy; and my expertise in probabilistic accident and failure analysis is very limited, I must make clear that my comments are not based on a detailed expert review of all the material presented. Thus, my review should not be interpreted as a detailed audit of the equations and results. Instead, I focused my attention on the overall framework and considered the extent to which the concerns of the 1996 peer review were addressed.

The accident analysis has been revised substantially from the version we reviewed in 1996. The hazard identification is more comprehensive and there has been a substantial increase in the mathematical sophistication of the methods used to estimate air concentrations at specific off-site locations during and after accidents.

The process used to define accident scenarios is still based primarily on qualitative and mostly subjective methods. The scenarios are based primarily on engineering judgment derived from experiences at WTI and similar facilities. For each accident scenario there is an extensive narrative used to justify the assumptions and likelihood estimates associated with the accident. Although this type of process is useful for screening out plausible "extreme" and "more typical" accidents, it lacks credibility relative to the more sophisticated fault and event tree methods used in the nuclear power industry and at some chemical process facilities.

In commenting on the accident analysis in the 1996 review, the peer review committee had one

important long term recommendation that more sophisticated accidental fire and chemical release models must be developed. We noted that it is unlikely that such models could be incorporated in the WTI assessment, but would be useful for future incinerator risk assessments. The revised accident analysis has made some progress in this direction, but in many ways this issue is still relevant, and it should be noted in accident analysis report that the absence of sophisticated accidental fire and chemical release models remains a short-coming of the analysis.

The introduction should provide the reader with a better summary of accidents considered, their likelihood, and consequences. Only some of this information is provided in the summary tables. I found it necessary to page all over the document to put some of this information together.

Response to the 1996 Peer Review

In general, I found the revised accident analysis responsive to many of the 1996 peer-review recommendations, but there are some areas where I found the revisions have not yet been fully responsive. For these issues, I recommend that additional efforts by made to better respond to the issues raised by the peer-review process. Listed below (in italics) are the major issues on the subject of accidents identified in the 1996 per review. Below each issue, I provide my assessment of how well the revised accident analysis has addressed the concerns of the 1996 peer review.

- *The accident analysis has not addressed all potentially important accident scenarios. For example, pressurized jet releases form the incinerator containment might occur and result in aerosol formation due either to mixing reaction of chemicals or as a result of heating by fire. Although the accident analysis in the draft assessment provides a useful beginning for assessing nonroutine emissions and accidents, it is not well developed and it lacks precision and depth needed for reliable estimates of impacts.*

  This comment involves two issue--an example of an accident scenario that might have been left out and the statement that the process for assessing non-routine emissions and accidents in not appropriately developed in the accident analysis. In responding to this comment, the EPA has focused only on the aerosol jet scenario (which was singled out to make the more important point regarding the accident analysis process). There is, as far as I can determine, no explicit response made to our concerns about the accident evaluation process and our comment that it "lacks precision and depth needed for reliable estimates of impacts." How the revised accident analysis addresses this comment should be explicitly discussed.

  With regard to the aerosol jet scenario that the peer-review panel identified, the EPA in responding to our comments (Volume VIII) evaluated the possibility of this scenario and decided not to include it because they have determined it has a low likelihood. I believe this response fails to address

both the specific and the broader comment and the ground rules of accident risk analysis. Any plausible or possible scenario should be assessed along with its associated probability. If, indeed, the probability of this event is low, this will show up in the final results. A probabilistic analysis should not be based on excluding scenarios, but including all plausible scenarios along with a quantitative likelihood estimate to justify the "premise" of low likelihood. I recommend that this scenario should be included in the accident analysis. It could still be excluded as an important contributor to exposure and health effects, but this exclusion should be based on a more quantitative analysis of the relative likelihood of this event and the sub-events or faults that give rise to this event.

- *The predicted effectiveness (or failures) of mitigation measures needs to be more clearly addressed.*

  This comment has been only partially addressed. Our intent in making this comment was to encourage the EPA and its risk assessment contractors to apply some level of event and fault tree methodology to any assumed mitigation measure. Instead they have used a range of release-time durations to represent the impact of mitigation. Thus, instead of explicitly assessing the reliability of or potential failures of any assumed mitigation (i.e. relieve valves, fire suppression, standard operating procedures, etc.), mitigation is simply represented by release duration. In my view, the accident analysis would be much more informative if there were a more explicit evaluation of which systems are assumed to be working properly and which are assumed to have failed during various accident scenarios.

- *The report does not adequately express or communicate the expected value of harm for accidents. The severity and consequences information is expressed in such hard-to-interpret phrases as "likely" and "unlikely" events and "moderate " to "catastrophic " consequences. Some more quantitative precision with respect to these terms would be useful.*

  This comment has also been only partially addressed. The revised document still very much relies on subjective terms such as "minor", "moderate", "major" to communicate the occurrence of fatalities and injuries off-site and qualitative terms such as "likely", "reasonably likely", "unlikely", and "very unlikely" as way of communicating the frequency of accidents.

- *The accident scenarios do not include in any quantitative fashion the of sequence of events that result in an accident or of the likelihood of these events. The absence of this information hampers the use of the accident analysis as a guide for planning to reduce the incidence and consequences of accidents in an efficient*

and cost-effective manner.

The revised accident analysis does not address this issue. In explaining why it is not addressed (Volume VIII), the EPA states that accident scenarios were selected only to capture the consequences of worst-case and more typical accidents. I am concerned with the logic of this response. For accident analysis studies that have been carried out in other industries, such as nuclear-power plant accident assessments, the so-called "typical" and "worst-case" accidents are scoped out by using "event trees" that characterize the of sequence of events that result in an accident and the likelihood of these events. Event trees are commonly used in many types of failure-analysis studies, because they provide a visual "road map" for how any set of failures can lead to a release of toxic materials. Without such analyses it is difficult to evaluate whether a comprehensive set of accidents has been considered.

- *The IDLH values used in the accident analysis are designed to provide short-term protection to healthy workers and do not account for the greater variation in sensitivity likely to exist in a non-occupational population that includes children. The committee is of the opinion that some other measure of accident health impacts be considered. It was noted that the American Industrial Hygiene Association's Emergency Response Planning Guidelines (ERPG) levels would probably have been more appropriate than IDLH values for characterizing the severity of accident consequences.*

  This comment has been addressed through the use of Level of Concern (LOC) values in the revised report.

- *The accident analysis would be strengthened by giving consideration to the safety record of other similar hazardous waste facilities such as the Biebesheim facility in Germany, which is similar to WTI and has apparently reported two release incidents.*

  This comment has not yet been fully addressed. The revised accident analysis includes information on the accident records of other similar hazardous waste facilities, but does not include the specifically-requested information from the Biebesheim facility, because the EPA claims (in Volume VIII) that they could not obtain this information from the German Government in a timely manner. Thus, in my view this question has not yet adequately been addressed and should be when the information from Biebesheim can be evaluated.

- *The accident analysis focuses on the acute impacts of the accident scenarios but does not address how chemical exposures during an accident could impact an*

individual's lifetime exposures to chemicals from the WTI facility.

The EPA has responded to this comment (in volume VIII) by stating that such an analysis would be very difficult to carry out in a way that provides representative values for any specific individuals and could require a large number of highly uncertain assumptions. I concur with their analysis.

- *The atmospheric dispersion analysis used in the accident analysis should explicitly report the chemical concentration ranges expected to occur at the East Elementary School under the various accident scenarios,*

  The EPA has responded to this comment by adding a characterization of exposures at the school in the revised accident analysis.

- *The chemical-release model for accidental fires should be changed to include the same chemicals and relative emission rate estimation procedures used for the stack emission. In addition, an improved method for calculating the total emissions rate from the fire should be developed.*

  As far as I can determine, the EPA has fully responded to this comment in the revised accident analysis.

- *The dispersion modeling performed for the accident scenarios should be re-examined in light of the committee's recommendation that the calm/stagnant conditions should be re-analyzed with a more appropriate data set in the CALPUFF model.*

  Based on my review, the EPA has responded appropriately to this comment in the revised accident analysis.

- *The model used to estimate the rate of chemical evaporation from spills is not appropriate for calm conditions. More appropriate models are discussed in the report of the sub-committee on atmospheric dispersion.*

  Based on my review, the EPA has responded appropriately to this comment in the revised accident analysis.

- *Because this facility is located on a flood plane, the risk assessment should include both the likelihood of occurrence of a flood of sufficient magnitude to inundate the facility and the likelihood that hazardous materials would be released during such a flood.*

The EPA has responded to this comment (in Volume VIII) by calculating the likelihood of flood waters intruding to the WTI facility. As far as I can determine, this analysis is responsive to our comment.

- *Because acetone has now been deleted from the list of toxic chemical used for emergency planning, the committee recommends that it not be used as a sentinel chemical for the accident analysis.*

  The EPA has responded to this comment by providing justification to retain acetone as one of the chemicals used to evaluate the on-site spill scenario.

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Walter F. Dabberdt
Associate Director

May 19, 1997

Dr. William P. Wood
Executive Director
Risk Assessment Forum
U.S. Environmental Protection Agency
Washington, DC 20460

Ref: WTI Risk Assessment

Dear Dr. Wood:

Attached are my comments on the accident analysis (Vol. VII) of the risk assessment for the WTI toxic waste incinerator. They should not be taken as a comprehensive peer review of the document given the limited period of time available (at least to this reviewer) to read the document and develop useful comments and the lack of interaction with the other reviewers and with the study's principal investigators and the various agency program managers. This is an important study of a very sensitive issue, and one that has been in process for nearly three years. While it is my considered opinion that the study has probably reached appropriate conclusions, the process has been cumbersome and the methodologies used do not always represent the best available science. Similarly, the peer review process -- especially this final review -- does not have a level of rigor that is commensurate with the sensitivities of the problem.

To the extent feasible, I have tried to address the various questions posed in your letter of May 2, 1997. I will try here to succinctly address them here as well.

- Yes, SLAB does provide conservative estimates of concentration for dense gases when the receptor is at a higher elevation than the source because SLAB assumes flat terrain.

- ISC3 does not further our understanding of the issues.

- I cannot offer an experienced view on the value of the RHR approach per se.

- I believe there could be improvements to the estimates of concentration at the East

Elementary School.

Sincerely,

Walter F. Dabbert

Comments on Revisions to the WTI Risk Assessment:
Dispersion Modeling and Accident Analyses

Walter F. Dabberdt
Boulder, Colorado
May 17, 1997

General Comment: This review of the revisions to the accident analysis of the WTI risk assessment provides comments on the general methodology and overall conclusions as presented in Volume VII.

Dispersion Modeling: Insofar as the dispersion modeling for the accident scenarios is concerned, the results (expressed as a range of distances to LOC and IDLH concentrations) likely bracket the 'true expected values. However, the process for reaching these conclusions could have been strengthened in several ways. First, the report should have presented a thorough rationale for using the three dispersion models (ISC, CALPUFF, and SLAB) in the manner employed in the analysis. Second, the report would have been strengthened had it contained a detailed description of the physical basis for and parameterizations used in each of the three models. Third, it is unclear why these models were actually used. Given the complexity of the orographic setting of the plant and the distribution of sensitive receptors, and given the inability of the physics of the ISC and SLAB models to properly simulate advection in complex terrain, the choice of these models is difficult to justify. The entire process then begs the question: how should dispersion modeling be done in a setting that cannot be rigorously modeled with the available regulatory models? Rather than providing leadership in this difficult problem, the present study used archaic and limited methodologies. Does this mean the quantitative results do not provide a conservative assessment of the dispersion aspects of the risk assessment? Probably not, although as discussed below the upper bounds of the level of risk and the probability of occurrence may be somewhat understated. Lastly, the interpretation of the dispersion modeling results would have been strengthen had it incorporated the uncertainty that is inherent in such models. This uncertainty, typically given as a factor of two-to-three in the estimate of concentration, would have resulted in increased distances to the LOC and IDLH levels.

Aspects of the Meteorology: In the analysis of the risk to the children at the East Elementary School, the frequency of occurrence of the school being downwind of the plant is based on meteorological data obtained from WTI. It is very likely that the wind data obtained from the WTI meteorological measurement mast are inadequate for this purpose because of the topography of the valley and the location of the school, and therefore the likely limited representativeness of the WTI wind data. Also, the arc of wind directions which will result in impacts to the school is open to question. Twenty degrees may be too small in light of the uncertainties in the wind data and because of the tendency for obstructions near to the source to increase plume spread in the near field.

Probability Analysis: Probabilities are calculated using the joint probability of an accident occurring and the relevant meteorological conditions present. A significant limitation of this approach is the small sample size (that is, the small data base on rate of accidents at similar facilities). The approach used is to aggregate all such data, in essence taking an average of such probability over all plants. To achieve a conservative estimate of risk, it would be more appropriate to consider the frequency of accidents associated with the plant with the highest accident rate. Similarly, the frequency of occurrence of poor dispersion conditions (that is, high concentrations) would be greater if the model uncertainty of a factor of two-three had been incorporated. As a final note, I pose the following question: what would have been the conclusion if the present methodology had been applied in an assessment of risk for the other plants and facilities that had accidents actually occur? Would the analysis have demonstrated a significant risk?

Summary Comments: The amended risk assessment pertaining to the accident analysis for the WTI facility represents in some ways a very thorough and detailed analysis while on the other hand it uses methods and assumptions that are open to some question. The estimated distances to LOC and IDLH concentrations are probably somewhat understated because of the failure to explicitly consider the uncertainty inherent in the dispersion model simulations. The choice of models used likely provides results that otherwise reasonably bracket the expected concentrations, although these models are not well matched to the environmental setting of the plant's location in a steep river valley. Lastly, the ability to provide a robust estimate of the probability of occurrence of such accidents is limited by the small size of the data base for operation of similar facilities.

Department of Pharmacology & Toxicology
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Mary E. Davis, PhD. Box 9223, 305/293-3414, Fax 6854, mdavis@wvu.edu

Mary E. Davis, Ph.D.

William P. Wood
Executive Director
Risk Assessment Forum
Office of Research and Development
United States Environmental Protection Agency
Washington, DC 20460

Dear Dr. Wood:

I have reviewed the additional material on the accident analysis of the WTI risk assessment. Overall, the accident analysis is improved over the previous version and is a useful and important addition to the risk assessment.

In my review, I compared the revision against the comments on the previous draft. The Toxicology Work Group made near-term recommendations:

1. to select a chemical other than acetone,

2. to use LOCs,

3. to consider the long-term sequelae of an accident and

4. to explicitly consider effects on the East End Elementary School and to estimate worst case concentrations that would occur at the school.

In addition several long-term recommendations were made, including one to develop an accident classification system more relevant to relatively discrete accidents occurring in small communities.

In the revised accident analysis, LOCs were used, effects on East End Elementary were considered and a better classification system was developed. In the revised version, there is emphasis on choosing chemicals as surrogates of a class of chemicals, so this issue has been addressed somewhat. Long-term sequelae of the exposures that occur during accidents are not addressed. The revision does note that the accident analysis evaluates acute health effects and discusses a role of helping emergency planning efforts. The Toxicology Work Group was concerned that exposures from accident scenarios would be higher than those predicted to occur during routine operation of the plant and therefore should be included in estimating life-time exposure to chemical hazards arising from the WTI plant (either planned or unplanned).

I don't have the expertise to judge the appropriateness or usefulness of the various air-dispersion models.

I think the Relative Hazard Ratio approach and estimates of occurrence are reasonable. A different approach, of defining geographical areas or zones in which an off-site would result in high, medium or low concentrations (at the school), under prevailing wind conditions and several other classes of wind conditions, would be useful for those planning emergency responses to off-site accidents. That is, in the event of an off-site accident, the wind direction would determine which map to use to locate the accident and, depending on the zone it is in, predict the relative exposure to the school. I think listing the predicted upper bound concentrations at the school was helpful.

The discussion of the relationship between the locations of WTI, East End Elementary School and historical wind direction was very informative.

Editorial comment:

On page VI-14, the first paragraph under (ii) Waste Composition: is the likelihood of a "typical" waste spill considerably lower than the likelihood of a "worst-case" spill? The paragraphs that follow suggest that the "typical" spill will occur ten times more often than the "worst-case" spill.

Overall, I think the revised accident analysis is greatly improved and the comments of the Toxicology Working Group have been considered. If I was reviewing this for publication in a journal I would recommend that it be accepted for publication.

Sincerely, Mary E. Davis, Ph.D.
Professor

DEPARTMENT OF ATMOSPHERIC SCIENCES, BOX 351640
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One More Review of the EPA Risk Assessment of the Waste Technology Industries [WTI] Incinerator at
East Liverpool, Ohio.

In January of 1996 I participated in a peer review of the EPA's Region V risk assessment for the WTI incinerator at East Liverpool, Ohio. As part of that process I and others recommended additional accident analyses, including an examination of the accident records of similar plants, the use of non-steady-state dispersion modeling of pollutant
impacts, with real winds, complex terrain, and an emphasis on stagnation events, and the consideration of other contributors to air-quality degradation in the air shed.

The assessment process has responded in varying degrees to the first two of these recommendations. I appreciate the engineering competence of these responses in what must seem to be an interminable task. While I have reservations about certain details of these responses, I accept that my objections would not likely affect broad conclusions, beyond their inherent uncertainties.

The material that I have recently reviewed [*] does not discuss the present air quality in the valley as a whole. This is, I judge, a serious deficiency in the Risk Assessment Process: decisions should be made at the margins, not from base zero.

The study reports the climatology of winds [well measured over approximately one year] but not the climatology of the air-quality [PM10, PM2.5, CO, SOx, NOx, 03, ..], which is closer to what we really want to know. The air-quality models over which we debate niceties are just recipes to estimate the concentrations of these and other atmospheric tracers, under assumptions about emissions and winds. But what are the actual measurements? How often do the "criteria" pollutants exceed federal standards? Are the additional emissions by WTI, in both normal and accidental conditions, expected to increase the frequency or severity of exceedances? By how much?

In my contribution to the 1996 review I expressed a judgment [with supporting references] that the most acute community impact of air-pollution is bronchial-pulmonary distress, and that a good index of this is emergency-room admissions for asthma, particularly among children and the elderly, and the correlation of these admissions with weather and air-quality indices. No data of this type were addressed in the present response.

The preceding comments conclude my technical review. Please permit me two less technical remarks:

It is my understanding that a final presentation of the Risk Assessment was delivered to the East Liverpool community last Thursday, May 8th, [without opportunity for comments], and that an Executive Summary is presently circulating, in draft form. This would appear to moot my present contribution to this Assessment. This is vexing.

This ex-post-facto Risk Assessment process has produced distracting verbiage that obscures a simple truth: it was wrong to permit the construction of a toxic-waste incinerator on a flood plain of a narrow river valley, adjacent to a school.

Respectfully,

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[*] “Additional Analyses in Response to Peer Review Recommendations Chapter VII with appendices VII-1,2,3,4,5, and Chapter VIII with attachments 1.2.3.4.5

FLUID MECHANICS
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Engineering Research Center,

William P. Wood
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Your Ref: Letter of 2 May 1997
Subject: Additional review comments on WTI Hazardous waste incinerator

Dear Dr. Wood:

I have scanned over the revised Volume VII materials and appendices provided in your package of 2 May 1997. I understand my charge as a reviewer was to consider the revisions to the accident analysis related to the assessment prepared for the East Elementary School near the WTI installation. My comments are contained in the following bulleted paragraphs.

- The SLAB air dispersion model, used for the dense gas releases in the accident analysis assumes flat terrain while the East Elementary School is at a higher elevation than WTI. As a reviewer I have been asked to comment on the premise that the SLAB program will provide conservative concentration estimates in a situation where the terrain rises (See Ch VII, VI-D-2, pages VI-27 & 28).

I have extensive experience with models based on the concept of depth-integrated or section integrated dispersion such as SLAB. I have personally used SLAB, DEGADIS, and my own models DENSE and DENS3D to predict dispersion on flat, sloped, and complex terrain under conditions of neutral and stable stratification in the presence of barriers, fences, hills and gorges. In 1988 my student John Lee and I performed calculations of the behavior of dense clouds released on different slope hills (1:20 and 1:10 slopes). As shown in the attached figures 35 and 45 the uphill progress of the spill actually ceases under low-wind conditions and the width of the plume reduces. As shown in the attached figures 36 and 46 the up slope concentrations are lower than the equivalent zero slope or downslope concentrations at a given distance from the spill. Although these calculations are not for exactly the same size release, density, or meteorological conditions studied in Chapter 7, I infer that it is reasonable to expect that the SLAB program as utilized will give CONSERVATIVE results relative to actual concentrations which might occur at

the East Elementary School under otherwise equivalent conditions.

(Note: without specific calculations I could not estimate the magnitude of factor of safety associated with uphill dispersion. If fiscal resources were made available I could arrange to calculate specific concentrations using our program DENS3D.)

- This reviewer was asked if calculations with the ISC3 model, which contains options to include the effect of complex terrain, contributes any understanding to the terrain effects. (See Vol. VII, Last paragraph, bottom page VI-27 and top of page VI-28).

It is my understanding that the ISC-3 model calculates terrain effects by assuming that the concentrations at ground-level will be equivalent (due to impact) to concentrations at elevated locations equivalent to the ground deviation between source and sample location. This approach is relevant for elevated plumes which may (perhaps) be assumed to impinge on hills or ridges downstream. Since the plume may also be expected to follow surface streamlines to some extent this results in a conservative result for conventional elevated point source releases.

It would not appear to be relevant or in any way equivalent to a ground level release of dense gases. If an elevated source is indeed appropriate, then a program like the EPA RVD2.0 Relief Valve Screening Model, EPA-450/4-88-024 based on the work of Hoot, Meroney, and Peterka (1973), which includes the effect of gas density, vertical exhaust, source elevation, etc. on plume trajectory should be used. Hence, I would conclude the calculations using ISC-3 in this case are INAPPROPRIATE and add nothing to the discussion. I suggest this paragraph be eliminated from the text.

- The Relative Hazard Ratio (RHR) approach (Ch VII, page VI-28) coupled with estimates of relative occurrence, seems a good way to illustrate the relative impact of various release scenarios on potential receptor locations. I applaud the use of the LOC values rather than the IDLH values in this parameter, since the magnitudes are consequently less conservative appearing and do not appear to "undervalue" the significance of any potential dangers.

- The RHR approach appears to be a good way to present relative risk; however, it might also be appropriate to include more conventional risk measures in this document. For example many toxic hazard, nuclear and other risks are presented in terms of the chance of accident in a given year (eg. 1 in 100 thousand) vs deaths expected if the accident occurs (See enclosed figure 3 from Lathrop and Linnerrooth, 1981). I suggest this because it is often difficult to relieve people's perspectives concerning risk with a single unidimensional index of death or disability (See Slovic, "Perception of Risk", AAAS Science, Vol. 236, 1987, pp. 280-285.). Slovic remarks that "psychometric research implies that risk debates are not merely about risk statistics but may be a surrogate for other social or ideological concerns. When this is the case, communication about risk is simply irrelevant to the discussion. Hidden agendas need to be brought to the surface and discussed."

- Given that the revised volume was not provided in red-line form (marked to indicate changes), I am unable to remark on specific changes in this volume vs earlier versions of the

report. Nonetheless, I feel that the inclusion of Chapter revisions related to the impact of dispersing toxics on the specific site of the elementary school are useful.

Sincerely yours,

Robert N. Meroney, Professor
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Enclosures: Various figures

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29 May 1996
Reference: 00700.28

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Re: Follow-up peer review of the accident analysis portion of the Waste Technologies Industries' (WTI) hazardous waste incinerator risk assessment

Dear Mr. Wood:

This is in response to your letter to me dated May 2, 1997 in which you- requested my participation in the subject review. As you know, I was a- member of the Air Dispersion/Deposition Modeling and Accident Analysis subgroup of the agency-sponsored peer review of the WTI risk assessment conducted in 1996. I have reviewed the material provided in your May 2 letter, and have focused on responding to your request which was to review and comment on the revisions to the accident analysis
(Volume VII of the risk assessment) related to the assessment prepared for East Elementary School. The primary material that I focussed my review on is contained in Section VI.D of Volume VII, and includes a good deal of supporting material in additional attachments and appendices.

In order to ensure that my response to your request is expressed in the proper context, I repeat the questions posed by you in your letter prior to presenting my response.

Question: The SLAB air dispersion model, used for the dense gas releases in the accident analysis,
assumes flat terrain while the East Elementary School is at a higher elevation than WTI. The Agency believes that the use of the SLAB model provides conservative concentration estimates in complex terrain applications. Therefore, the ISC3 model was used to develop a better understanding of how terrain effects might influence concentrations at the height of the school.

Do you agree than 1) the SLAB model provides conservative concentration estimates at the school and 2) that the ISC3 sensitivity analysis contributes to our understanding of the terrain effects?

Response: As I stated in my original review, I believe that the SLAB model is an appropriate tool to assess the impacts of the release types (essentially on- and off-site spills of toxic materials) for which it was used in this analysis. The SLAB model was also used by EPA to develop conservative look-up tables for determining distances to toxic endpoints in its "Offsite Consequence Analysis Document" recently released for use in the Clean Air Act Section 112(r)

Risk Management Plan Program. Model inputs as presented in Section VI and Attachment VII-4 appear to be appropriate for application to the WTI accident analyses.

The influence of terrain on the transport and dispersion of pollutant material released near the ground has its primary effect in modifying and sometimes diverting the air flow approaching a terrain obstacle. Whether the flow tends to continue towards an obstacle and rise over it, or is diverted around the side of the obstacle, is a complex function of the terrain shape and the speed and temperature structure of the approach flow. Generally, with less energy in the approach flow (i.e., lower speeds) and a positive potential temperature gradient (i.e., stable conditions), the flow tends to be diverted around the side of the obstacle. This effect would be enhanced if the pollutant material is denser than air, as pointed out in Section VI. Thus, the conditions modeled for worst-case dispersion (low wind speed, stable conditions) would be those that would tend to divert the pollutant cloud around higher terrain.

This tendency, of course, does not prove that the school would not be impacted by the release from an accident. It is, however, a legitimate factor to consider qualitatively in interpreting the SLAB results which do not allow for any plume deflection at all. I believe that SLAB provides conservative estimates at the school, but primarily because of the conservative nature of the model itself which belief is strengthened by the terrain issue.

I do not think that the ISC3 sensitivity modeling adds a whole lot to understanding terrain effects. No documentation was provided that shows how the spill source was characterized in ISC3; the 10-fold reduction in concentrations could be due to source characterization, or to dispersion parameters, or to other factors unrelated to terrain. Although it does not contribute directly to understanding terrain effects, it is still worth noting that the model produced much lower concentrations and does add to the sense that SLAB results are providing conservative estimates.

Question: Is the Relative Hazard Ratio (RHR) approach, coupled with estimates of relative occurrence, appropriate for identifying those accident scenarios with the greatest potential to cause adverse health effects at East Elementary School?

My reaction to the RHR approach was that it is a very effective way to screen out scenarios that are not likely to be of any consequence, and coupled with estimates of relative occurrence provides a practical way to sift through what would otherwise be a confusing set of numbers. In my opinion, this approach is appropriate for identifying accident scenarios of most concern with respect to health effects at the school.

Question: Is the approach to developing the probabilities of achieving the estimated concentrations and RHRs at East Elementary School appropriate?

The estimated probabilities appear to have been arrived at in a way that is reasonable and appropriate. I do not consider myself to be an expert in assessing these probabilities, but I cannot find any serious flaws in the reasoning.

I have read through all of the material that you provided in your May 2 letter and did not find anything that would alter my responses to the questions posed above. I continue to believe that this risk assessment represents a genuine, dedicated effort on the part of EPA Region V to address issues that I understand are of some considerable
concern to members of the community.

If you have any questions about this review, or need additional information, please do not hesitate to contact me.

Mark Garrison, ***Air Quality Meteorologist***

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Comments on the Revision to the Accident Analysis for the Waste Technologies Hazardous Waste Incinerator Located in East Liverpool, Ohio

Prepared by: Jerry Havens, Distinguished Professor of Chemical Engineering, University of Arkansas

My comments address only Section IV - "Accident Analysis", of Volume VIII - Additional Analysis in Response to Peer Review Recommendations" and are limited to Section 1 - Pressurized Jet Release and Section 2 - Mitigation Measures.

In the following, I first restate the Peer Review Panel's comment and EPA's response and then provide my review comments.

PRESSURIZED JET RELEASES

The Peer Review Panel's comment was:

"The accident analysis does not address all potentially important accident scenarios. For example, pressurized jet releases from the incinerator containment might occur and result in aerosol formation due to mixing of chemicals or heating by fire. Although the accident analysis in the draft assessment provides a useful beginning for assessing nonroutine emissions and accidents, it is not well developed and it lacks precision and depth needed for reliable estimates of impacts".

EPA's response was:

"In response to the Peer Panel's concern we re-evaluated the possibility of such a pressurized

aerosol jet scenario for inclusion in the accident analysis. The pressurized aerosol jet scenario discussed by the Peer Panel involves the rapid release of a large amount of hazardous liquid, at high velocity and high pressure, through an orifice which would result in the atomization of much of the liquid. The EPA believes that the analysis of such a scenario is extremely important because such an event could result in a very large quantity of material being very quickly introduced into the environment. In such a scenario, the atomized liquid could rapidly volatilize due to the large surface area of the droplets, and there would also be a significant potential for a mist cloud."

My response:

I agree that analysis of such a scenario is extremely important because a very large quantity of material (in aerosol form) could be released into the environment. The Bhopal catastrophe was the result of a runaway reaction in a (similar size) storage tank which contained methylisocyanate contaminated with water. The WTI storage tanks under consideration contain mixtures of hazardous chemicals. The compositions of such mixtures is not well known, and the composition changes frequently due to additions or withdrawals. I am concerned that incompatible materials could be introduced into the tanks resulting in rapid pressurization. It is well known that such events can lead to large releases of aerosol which can be much heavier than air, thus forming clouds which can have high concentrations of hazardous chemicals and therefore severe impact on the community and the environment. As evidenced by the Bhopal catastrophe, such an event can have disastrous consequences. Such a release at WTI would also be confined in the valley and would not be dispersed as rapidly as occurred in Bhopal. The (natural) release of a very large quantity of carbon dioxide cloud in a river valley in Cameroon resulted in severely high gas concentrations in the valley several miles downwind. The Cameroon release was extremely large in comparison to that which could occur under any conceivable circumstances from the WTI facility. However, concentrations of carbon dioxide of order ten percent apparently persisted for miles in the Cameroon valley, whereas ppm concentrations of some of the materials stored at the WTI facility could be very dangerous.

EPA then summarized their analysis of the potential for such a scenario:

A: The waste storage tanks at WTI are all designed to be operated at atmospheric pressure. None of the waste storage tanks at WTI are pressure vessels, and WTI does not receive bulk pressurized gases. Review of the facility drawings and inspection of the plant confirm that each tank has both a normal venting system and a rupture disk, designed to prevent rupture of the tank. The rupture disks on each of the waste storage tanks are calibrated to break at 15 psig, and this value establishes the maximum pressure that a tank full of waste could experience. This means that high tank pressures would not be involved.

My response:

EPA's response is not adequate. Although the WTI tanks in question (designed for liquid storage) are not "pressure vessels," any vessel (of this type) has a design maximum operating pressure, and the designated rupture disk pressure of 15 psig indicates the pressure at which failure of the vessel(s) would be expected is substantially higher (than 15 psig). THE RUPTURE DISK PRESSURE DOES NOT ESTABLISH THE MAXIMUM PRESSURE THAT A TANK COULD EXPERIENCE. In this scenario the maximum pressure would be determined by the balance between the rate of pressurization (due to reaction) and the capacity of the relief system to discharge the contents of the vessel. In Bhopal the pressure relief was set at about 40 psig, but the pressure in the vessel rose much higher and the vessel approached massive failure.

> Each waste tank has a combination vapor/overflow pipe which goes to an overflow tank (e.g., the
> 20,000 gallon, and 7,000 gallon waste tanks all discharge to 2,000 gallon overflow tanks; the 2,500 gallon waste tanks discharge to a 300 gallon overflow tank, etc.). The overflow tanks serve
> both to collect liquid overflow and to act as a knockout" for any liquid material potentially suspended in gases coming from the associated waste tank. The overflow tanks are connected via
> relief valves to the vapor collection system, which actively draws gases either into the primary air
> system of the incinerator or into an activated carbon bed absorption system. The venting system is
> not directly vented to the atmosphere.

My response:

It is highly unlikely that the overflow tanks, which are primarily designed to catch liquid overflow, would function effectively to "knockout much suspended liquid material. The scenario of concern here involves the extensive formation of aerosols which (by definition) would not be removed "by knockout in the overflow tanks. With regard to the venting of the overflow tanks to the vapor collection system, which exhausts either to the incinerator or into an activated carbon bed absorption system, I am convinced that neither of the latter units are designed to handle the flows of material that would be anticipated in the accident scenario under consideration. In Bhopal the relief valve discharged into a header and thence into a scrubber and a flare stack before entering the atmosphere. In the event, neither the scrubber nor the vent stack were operable. It is well known that had either or both been operating at design capacity, either would have been hopelessly overloaded since their design anticipated much more “normal” operating conditions than were experienced in the accident.

C-D. As mentioned above, each waste tank also has a rupture disk for the purpose of saving the associated tank from rupturing if the primary vent system (i.e., the immediate piping sections of
the vapor/overflow collection system) should become blocked or restricted. Under the present

design, the rupture disk on each of the storage tanks exhausts into a short length of pipe which
then vents outside the building, one pipe for each tank. Under certain very limited conditions, an
overpressurization of one of the tanks, as might be caused by mixing of severely incompatible wastes, could result in a rupture of one of these rupture disks and the expulsion of some waste
material outdoors. -- Because the wastes stored in the tanks are not pressurized, we believe that in
the event of a rapid tank pressurization (such as could conceivably occur upon mixing of severely
incompatible materials) which turned out to be greater that the primary vent system could handle,
any material expelled upon rupture of the rupture disk would be in gaseous form. However, if gases evolved so rapidly within the tank as to cause foaming of the liquid material, some amount
of liquid might be entrained with the escaping gas. Because of the relatively low pressures involved, however, aerosols would not be expected.

My response:

<u>This is wishful thinking. My concerns here are the same as in A & B above. I believe my comments above are equally applicable here.</u>

E-F. The Permittee is at the time of this writing pursuing two permit modifications relative to the venting of these waste tanks. The first permit modification proposes to increase the diameter of
the tank overflow piping to better handle the flow of liquid and gas. This system was designed to
handle normal tank breathing and routine vapor releases, as well as tank overflows, and this proposed change will provide it with a greater flow capacity. Increasing the capacity of this system will reduce the potential for activation of a rupture disk. -- The second permit modification
proposed by the Permittee involves piping all of the rupture disk outlets together into a common
18" header, and routing that header directly to the incinerator or carbon beds. These would therefore no longer vent directly to the atmosphere. With this new system, if a tank rupture disk
were to rupture, the escaping gas or gas liquid mixture would expand into the relatively large volume header pipe. This would promote a rapid reduction in pressure and reduction of flow velocity. Any ejected waste material would be captured and would flow through the piping system, eventually being drawn into the incinerator or carbon beds. At the time of this writing, it
appears likely that both of these permit modifications will be approved.

My response:

I am concerned that the modifications under consideration do not come close to providing for effective control of the accident scenario under consideration. Although the modifications proposed are in the right direction (as far as I can tell from the brief description) and would not be expected to have deleterious effects, their effectiveness should be carefully evaluated before accepting any potential for improvement of the situation.

EPA's summary paragraph of this section follows:

The EPA has concluded that with the installation of the new tank piping system described above, the probability of the release of a pressurized aerosol jet of waste would be extremely remote. Therefore, because the Permittee is taking measures which make the likelihood of such an event remote, the EPA has decided to not analyze this hypothetical event further at this time.

My response:

Given my responses above, I can only say that I could not arrive at EPA's conclusion. EPA appears to be willing to accept the Proposed modifications as sufficient measures to make the probability of a pressurized aerosol jet extremely (acceptably?) remote. I do not believe that the proposed measures are likely to be very effective in reducing the probability of the scenario under consideration, and I seriously doubt that the proposed modifications would mitigate such an accident if it were to occur.

MITIGATION MEASURES

The Peer Panel's comment was:

The predicted effectiveness (or failure) of mitigation measures needs to be more clearly addressed."

EPA's response was:

"The effects of mitigation measures were addressed in the sensitivity analysis. The sensitivity analysis shows that the maximum downwind distance of the LOC concentration decreases when active mitigation measures limit the emissions to a duration of 10 minutes. The sensitivity analysis also indicates there is no change in the maximum downwind distance should mitigation require 60 minutes. The purpose of the Accidental Release Analysis was to identify the area surrounding the facility that may be impacted by an accidental release. The effect of active mitigation measures is to decrease the affected area."

My response:

EPA's response is woefully incomplete. It is not clear to me how "the sensitivity analysis" could directly indicate anything about the efficacy of mitigation measures. One would expect that under

most conceivable circumstances the effect of active mitigation measures is to decrease the affected area. Nevertheless, disregarding such important considerations as the danger of using water (spray or deluge systems) on undefined waste (which might react violently with water), the statements made are essentially unquantified, and therefore of little value.